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TEXTILE RESEARCH

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The New Warp Sizing Study

THE Administrative Committee for the new warp sizing research met at N. C. State College Textile School, Raleigh, N. C., on Dec. 8. Chairman Carl R. Harris, Dean Thomas Nelson and Dr. W. E. Yelland were present, and also W. D. Appel, chairman of the Research Council. This was the first time that Mr. Appel and Dr. Yelland had visited the new textile building, and they were delighted to find the school so well equipped for the study.

Applicants for the position of research associate for the study were considered, and a selection should be made by the first of the new year; by that time also a new slasher especially equipped for this work should be installed. It is hoped also by that time that financing of the project will have been completed.

* * *

Committee on Wool Damage Project

CHAIRMAN W. D. Appel of the Research Council announces the appointment of the following committee to study the report of the conference on Wool Damage in Processing, held in conjunction with the Institute's recent annual meeting, and to draw up a research program and suggest ways and means of organizing, conducting and financing such a study: R. A. Lukens, vice-president, Continental Mills, Inc., Philadelphia, Pa., Chairman; Werner Von Bergen, Director, Research and Control Laboratories, Forstmann Woolen Co., Passaic, N. J.; Hugh Christison, Chief Chemist, Arlington Mills, Lawrence, Mass.; E. D. Walen, Agent, Worsted Div., Pacific Mills, Lawrence Mass., and Dr. Milton Harris, Director of Research, Textile Foundation Research Associateship, National Bureau of Standards, Washington, D. C.

* * *

Personals

Paul T. Cherington, member of the Institute's Committee on Economic Research, and a leading authority in the field of market and consumer research, has become a general partner in the firm of McKinsey & Co., management consultants, New York City.

* * *

Dr. Walter M. Scott, member of the Council and Research Committee of the A. A. T. C. C. for many years, and recently associated with Gustavus Esselen, Inc., Boston, has been appointed chief of the cotton chemical

finishing division of the Government Southern Regional Research Laboratory, New Orleans, La. It is announced that he will be responsible for research and development work to improve or modify chemically cotton fibre and its products.

* * *

Werner Von Bergen, research director, Fortsmann Woolen Co., Passaic, N. J., was the speaker at the meeting, Dec. 1, of the New York Section of the A. A. T. C. C. The subject of his address was "Quality Control in Woolen Mills."

* * *

Dr. Erwin J. Saxl, consulting physicist and chemist, Providence, R. I., has been engaged to conduct two Massachusetts University Extension courses starting Jan. 23 at Massachusetts Institute of Technology, Cambridge, Mass. One will be on "Rayon and Synthetic Fibres," the other on "Instruments for Consumer and Industrial Testing."

* * *

Frederick M. Feiker, general secretary of the American Engineering Council, and who has had charge of the Textile Foundation's educational program since 1934, has been made Dean of the School of Engineering of George Washington University, Washington, D. C. One of Mr. Feiker's notable services for the Foundation was the survey of textile schools and of the opportunities for trained men in the textile industry that was reported in a book on "The Training of Men for the Textile Industry." Many of the recommendations contained in that report have been carried out, and others undoubtedly will be in time. Mr. Feiker is a graduate of Worcester (Mass.) Polytechnic Institute and is eminently equipped for his new duties.

* * *

Carl C. Mattmann, Jr., with the A. M. Tenney Associates, New York, N. Y., is the nominee for president of the American Association of Textile Technologists. The other nominees are as follows: First vice-president, Randolph Semler, Duplan Silk Corp.; second vice-president, John Hagen, Callaway Mills; treasurer, George Urlaub, Throwsters Research Institute; secretary, Bernice S. Bronner.

* * *

Raymond Stevens, vice-president of Arthur D. Little, Inc., research consultants and engineers, Cambridge, Mass., has been appointed director of a nation-wide survey of research in industry to be conducted by the National Research Council. The survey is financed by a grant of the National Resources Planning Board. Dr. Ross G. Harrison, chairman of the National Research Council, defines the survey as "an objective study of industrial research as a national resource, as a means of aiding in its further development and utilization."

* * *

Dr. C. M. A. Stine, noted chemist who is a vice-president and director of the du Pont Company, has been selected by six of the leading chemical societies of the country to receive one of the highest international honors in the chemical profession—the Perkin medal of the Society of Chemical Industry for 1940. The award is to be made at a meeting in the Chemists' Club, New York, on Jan. 12.

Determination of Uronic Acids in Cellulosic Materials

By ROY L. WHISTLER, A. R. MARTIN, AND MILTON HARRIS*

A Textile Foundation Publication

Summary

Naturally-occurring cellulosic fibres appear to be a more or less intimate association of cellulose with other constituents, generally referred to as incrusting substances. A portion of these extraneous materials appears to be composed of uronic acids, presumably contained in the pectic substance of the fibres. Many of the important properties of these fibres, such as tensile strength, moisture and dye absorption, and viscosity in cuprammonium solution have frequently been considered as related to the presence of small quantities of pectin. In order to study this relationship in greater detail, it was necessary to develop a method for the quantitative estimation of pectin or its constituent uronic acids.

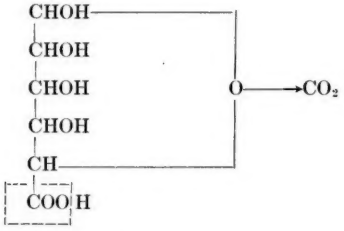
Available methods, based on the evolution of carbon dioxide during treatment of the uronic acid with a boiling solution of hydrochloric acid, were found to fail when cellulose or other carbohydrate materials were present, since these substances also decompose with the evolution of some carbon dioxide. An investigation of the rates of evolution of carbon dioxide showed that pure uronic acids evolved carbon dioxide at a rapid rate and that the evolution of gas was complete in several hours. On the other hand, carbohydrates, free of uronic acids, evolved carbon dioxide at a much slower but approximately constant rate during the entire treatment. It was found that this difference in rates could be utilized for the estimation of uronic acids, even when they are mixed with large proportions of cellulosic materials. A detailed description of the apparatus and its manipulation is given.

Introduction

As part of a program of research related to cotton fibre structure, it was necessary to measure the uronic acid content of cotton, both before and after the application of a variety of treatments. Such analyses necessitated the measurement of small quantities of uronic acids when mixed with large proportions of other carbohydrate material.

* Research Associates at the National Bureau of Standards, representing the Textile Foundation, Inc. This is the fifth publication of the new research program of the Textile Foundation at the National Bureau of Standards.

Uronic acids in contact with boiling solutions of hydrochloric acid undergo complete decarboxylation.



Proceeding from this observation, Lefevre and Tollens [1] developed a method for the quantitative determination of uronic acids. The decarboxylation of the uronic acid was accomplished by boiling in a solution of hydrochloric acid of specific gravity 1.06. A stream of carbon dioxide-free air, drawn through the apparatus, carried the evolved carbon dioxide from the reaction flask through a reflux condenser into a Peligot tube containing water to remove traces of hydrochloric acid, then through a drying tube, and finally into a weighed potash bulb. This procedure has since undergone numerous modifications.[2-11] The subsequent methods differ for the most part in the manner in which the carbon dioxide is collected and determined, and in the length of time necessary to bring the reaction to completion. The length of time recommended as necessary for complete decarboxylation has ranged from 3½ to 10 hours.

Although these methods gave good results when applied to pure uronic acids, considerable difficulty was encountered when they were used on such materials as cotton fibres or other carbohydrate mixtures. Under the drastic conditions employed in the analysis, it was found that uronic acid-free carbohydrates decomposed with the evolution of carbon dioxide. For example, when pure glucose was treated with a boiling 12% solution of hydrochloric acid, carbon dioxide was continuously evolved; the evolution was appreciable even after 30 hours. A study of the rates of evolution of carbon dioxide revealed that in the case of pure uronic acids there occurred an initial rapid evolution of carbon dioxide which ceased after several hours. On the other hand, carbohydrates which did not contain uronic acid groups evolved carbon dioxide at a much slower but approximately constant rate during the entire treatment with acid. A mixture of uronic acids with other carbohydrate material gave an initial rapid evolution of carbon dioxide followed by a slower but steady evolution of the gas.

During the time that the present work was in progress, there appeared three papers [12, 13, 14] from other laboratories, reporting findings relative to the evolution of carbon dioxide from a number of pure sugars and polysaccharides. Norman [13] pointed out that the presence of uronic acid groups could be inferred from the rate of evolution of carbon dioxide (a fact which we had noted independently) and stated that no quantitative significance could be attached to the small yields of carbon dioxide from polysaccharides.

In the present investigation, a critical study was made of the factors which influence the rates of evolution of carbon dioxide from uronic acids, glucose, and cellulose fibres during treatment with hydrochloric acid. As a

result of these studies, it has been possible to develop a new method for the precise estimation of small quantities of uronic acids in the presence of cellulosic materials.

Description of Apparatus and Method

The apparatus which was developed in this investigation is shown in Fig. 1. Two assemblies of the type shown were employed simultaneously; the same source of carrier gas and the same oil bath were used for both.

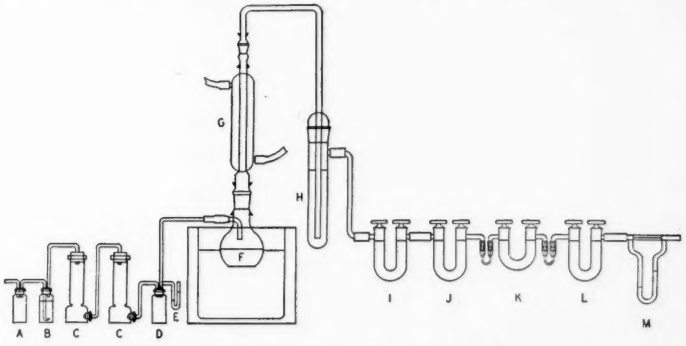


Fig. 1. Apparatus for determination of the rate of evolution of carbon dioxide from uronic acids or materials containing uronic acids during treatment with hydrochloric acid. (The apparatus is not drawn to scale. See text for dimensions.)

Nitrogen, which is used as the carrier gas for the evolved carbon dioxide, enters the apparatus through an empty safety bottle, *A*. It next passes through an alkaline solution of pyrogallol, *B*. The inlet tube in this bottle is drawn out to a small orifice which produces very fine bubbles. From *B* the gas passes through two absorption towers, *C*, filled with soda lime, into a second safety bottle, *D*, which is provided with a mercury manometer, *E*, and then enters the reaction flask, *F*, by way of a side arm whose outlet is 10 to 15 mm. above the surface of the liquid in the flask. The size of the flask depends upon the type of material and the size of the sample to be analyzed. In most of the experiments a 500-ml. reaction flask was used. From the reaction flask the gas passes through a 40-cm. reflux condenser, *G*, and into a bubbling tower, *H*, containing approximately 60 ml. of concentrated sulfuric acid. The sulfuric acid serves to remove interfering decomposition products which are carried over from the reaction flask.* The gas next passes through the *U*-tube, *I*, which is filled with anhydrous copper sulfate,** then through the tube, *J*, which contains phosphorus pentoxide, and finally through the carbon dioxide-absorption tube, *K*, containing ascarite, backed by phosphorus pentoxide. The absorption tubes,

* An aniline-hydrochloric acid mixture may also be used to remove volatile products but in our work was found to be less efficient than H_2SO_4.

** A precaution necessary in systems where chlorine or hydrogen sulfide might be formed.

K, are connected into the train by means of mercury-cup seals.[15] This type of connection makes possible a rapid exchange of the absorption tubes. Tube *K* is protected by a soda lime tube, *L*, which is followed by a calibrated flowmeter, *M*, for estimating the rate of flow of nitrogen through the apparatus.

The reaction flask is immersed in a vessel containing about 16 liters of hydrogenated cotton-seed oil. A bath temperature of 130° C. was found to be optimum for maintaining a steady but gentle boiling of the reaction mixture. The bath is brought to the operating temperature by means of two electric immersion heaters, one of 500 and one of 1000 watts. When the desired temperature is reached, the 500-watt heater alone is sufficient to maintain thermal constancy within $\pm$ 0.2° C. The time required to raise the temperature of the bath to 130° C. is approximately 50 min.

The sample to be analyzed is placed in the reaction flask *F*. The optimum size of the sample depends on its uronic acid content. When working with a material such as cotton, which contains a relatively small proportion of uronic acids, it is advisable to use samples of approximately 10 gm., although good results may be obtained with smaller samples. A sample of this size is readily covered by 300 ml. of the hydrochloric acid solution. Varying the ratio of acid solution to sample within reasonable limits does not affect the results. Thorough wetting of the sample by the acid solution is accomplished by evacuating the air in the flask with a filter pump.

The flask is placed in position in the oil bath so that the oil level is 3 to 4 mm. lower than the liquid level inside of the flask. This precaution is taken to prevent the baking of small bits of sample which may be splashed against the sides of the flask. Nitrogen, at the rate of about 10 liters per hour, is passed through the apparatus until the ascarite tube, *K*, shows no further gain in weight. This operation requires about 30 minutes, during which time the temperature of the oil bath is slowly raised to 50° C. When the apparatus is free of carbon dioxide, both heating units are turned on and the temperature brought to 130° C. This procedure is always carefully followed in order to assure the same preliminary heating for all samples. The point of zero time is taken as the time at which the bath reaches 130° C. At that time the ascarite tube, *K*, is removed for weighing and a second weighed ascarite tube inserted in its place. At the end of one hour, the second tube is removed for weighing and replaced by the first. This process is repeated at intervals of one hour for the duration of the analysis. When analyses are made on pure uronic acids or materials rich in uronic acids, a small amount of carbon dioxide is evolved by the time the temperature of the bath reaches 130° C. In these cases, this amount is measured and added to that evolved during the first hour.

Previous investigators have suggested that the tube entering the reaction flask, *F*, extend into the reaction mixture in order to prevent bumping. However, it was found that there is no tendency to bump when a 12% solution of acid and an oil bath temperature of 130° C. are used. On the other hand, it is found advantageous to have this tube terminate above the surface of the liquid. With this arrangement there is no tendency towards different amounts of agitation resulting from slight variations in the rate of flow of the carrier gas. Furthermore, there is less tendency for the gas stream to carry interfering products from the reaction mixture into the sulfuric acid tower, *H*. That no secondary reaction occurs from the action of sulfuric acid on the volatile substances, which interferes with the deter-

mination, was demonstrated by substituting a U-tube cooled in a mixture of solid carbon dioxide and trichloroethylene for the sulfuric acid tower, *H*. Identical results were obtained under both conditions.

The length of time required to sweep the carbon dioxide from the reaction flask into the absorption tubes was determined by the use of a known quantity of pure sodium carbonate. The sample was weighed in a glass tube, and the ends were sealed with paraffin. The tube was placed in an acid solution in the reaction flask and the train swept out with nitrogen. The temperature of the bath was then raised until the paraffin plugs loosened and allowed the acid to come in contact with the sample of carbonate. Since the reaction is extremely rapid, it was easy to determine the moment at which the carbon dioxide was released into the system. This procedure was repeated several times, a different rate of nitrogen flow being used in each case. It was found that with a gas flow of 10 liters per hour all of the carbon dioxide was absorbed by the ascarite in less than 30 min.

Experimental Results and Discussion

The rate of evolution of carbon dioxide from pure galacturonic acid monohydrate in 11, 12, and 13% solutions * of hydrochloric acid is shown in Fig. 2. The curves show that an initial, rapid evolution of carbon dioxide

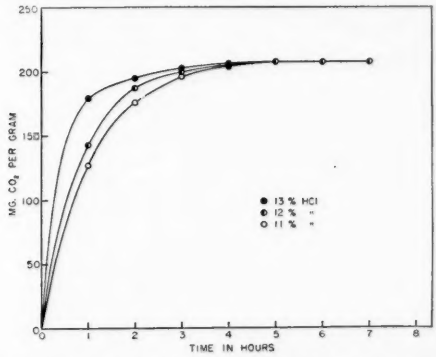


Fig. 2. Rate of evolution of carbon dioxide from galacturonic acid monohydrate.

occurs and that the evolution ceases after about four hours. A total of 208 mg. of carbon dioxide per gram of galacturonic acid monohydrate was obtained (the theoretical yield is 207.5 mg.). Increasing the concentration of acid increases the rate of evolution but does not affect the total amount of gas evolved.

Similar treatment of pure glucose in solutions of hydrochloric acid gives very different results, as shown in Fig. 3. The amounts of carbon dioxide evolved are small * compared with the amounts obtained from

* These solutions contained 110, 120 and 130 g. of hydrogen chloride per liter of solution.

* Because of the small amount of CO_2 evolved, 10-gm. samples of glucose were used for each analysis.

galacturonic acid under similar conditions. The rate of evolution increases with increasing acid concentration, but unlike the case of the galacturonic acid, the evolution of gas continues, except in the most concentrated acid solutions, at an approximately constant rate for the duration of the analysis.

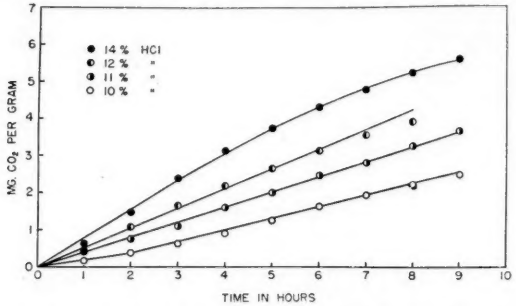


Fig. 3. Rate of evolution of carbon dioxide from glucose.

The amount of carbon dioxide obtained from pure glucose is very small compared with that obtained from pure galacturonic acid, but it is obvious that in naturally-occurring cellulosic materials such as cotton, which contain only small amounts of uronic acids, the amount of carbon dioxide evolved by that portion of the material which does not contain uronic acid groups may be an appreciable part of the total. This is shown by the curves for dewaxed cotton * in Fig. 4. An examination of these curves indicates that

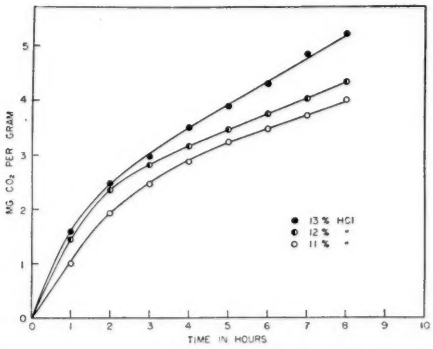


Fig. 4. Rate of evolution of carbon dioxide from dewaxed cotton.

they are probably composites of curves of the types found in Figs. 2 and 3. The rapid evolution of carbon dioxide during the first three hours, as indicated by the steep slopes of the curves, is characteristic of uronic acids. After the three-hour period the evolution of gas does not cease but continues

* Dewaxed cotton refers to cotton which has undergone 24-hour extractions each with alcohol and with diethyl ether.

at a slower but constant rate characteristic of carbohydrates which do not contain uronic acid groups. As in the previous experiments, the rate of evolution of gas increases with increasing acid concentrations.

On the basis of the results shown in Figs. 2, 3, and 4, a 12% solution (3.290 *N*) of hydrochloric acid was chosen as of a satisfactory concentration for the decarboxylation of uronic acids in the presence of other carbohydrate material.** In lower concentrations of acid, the decarboxylation of the uronic acids proceeds too slowly for convenience while in acids of higher concentration, the decomposition of the carbohydrate itself is too rapid and erratic. *Since the rate of evolution of carbon dioxide is appreciably affected by variations in acid strength, it is essential that the same concentration (within 0.02%) of acid be used in all comparative studies.*

That the results obtained with dewaxed cotton probably represent the behavior of a mixture of uronic acids and other carbohydrate materials was further indicated by studying the evolution of carbon dioxide from glucose, galacturonic acid and a known mixture of the two. The results are shown in Fig. 5. Curve *C*, which represents the total amount of carbon dioxide

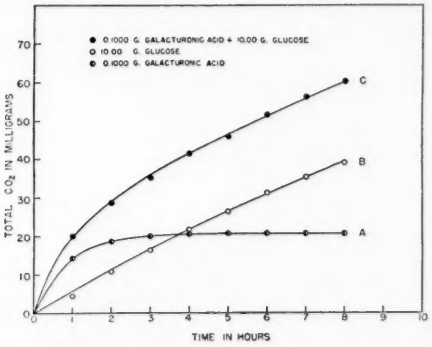


Fig. 5. Rate of evolution of carbon dioxide from glucose, galacturonic acid, and a mixture of both.

evolved from a mixture of 10.00 g. of glucose and 0.100 g. of galacturonic acid monohydrate, is similar in shape to the curves in Fig. 4. The total amount of carbon dioxide evolved by the mixture at any time, as shown by curve *C*, is equal to the sum of the amounts evolved by each of the components in the same time, as shown by curves *A* and *B*. The good agreement of the data is seen in Table 1.

Conversely, it follows that the amount of carbon dioxide evolved from uronic acid groups in this or similar mixtures can be readily estimated from the differences between the ordinates of the parallel portions of the curves *B* and *C*. The average of these differences, taken from the data in Table 1, is 20.5 mg. of carbon dioxide (theory, 20.75 mg.).

The curves shown in Fig. 6 were obtained from samples of dewaxed cotton and from cotton which had been purified by boiling for 7½ hours in a 1% solution of sodium hydroxide according to the methods recom-

** This concentration was used in all subsequent experiments.

Table 1

Evolution of Carbon Dioxide From Galacturonic Acid, Glucose, and a Mixture of Both.

Time	1 0.100 g. Galacturonic acid. (Monohydrate)	2 10.00 g. Glucose	3 1 + 2 Calc.	4 1 + 2 Found
hrs.	mg.	mg.	mg.	mg.
1	14.3	4.5	18.8	20.0
2	18.7	10.8	29.5	28.7
3	20.0	16.4	36.4	35.2
4	20.6	21.8	42.4	41.5
5	20.8	26.4	47.2	46.0
6	20.8	31.3	52.1	51.7
7	20.8	35.4	56.2	56.3
8	20.8	39.1	59.9	60.3

mended for the preparation of standard cotton cellulose.[16, 17, 18] With the exception of the induction period during the first two hours, the curve for purified cotton is similar in shape to that for glucose. It shows no initial rapid rise, characteristic of the uronic acids, and indicates that cotton purified in this manner is free from a measureable amount of uronic acids. The

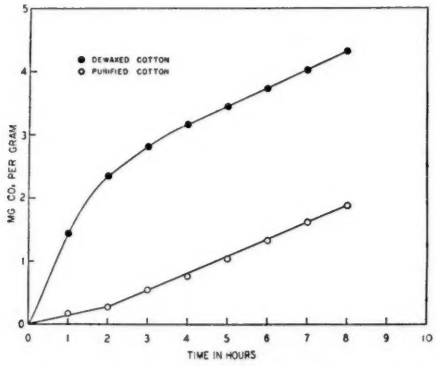


Fig. 6. Rate of evolution of carbon dioxide from samples of dewaxed and purified cotton.

amount of carbon dioxide evolved from the uronic groups in the dewaxed cotton is obtained by taking the average distance between the parallel portions of the curves, which gives a value of 2.4 mg. of carbon dioxide per gram of cotton.

It has generally been assumed that the uronic acids in native cotton are contained in the pectic * substance of the fibre. Further evidence for

* Pectic substance has been defined by the A. C. S. committee on nomenclature of pectin [19] as a complex carbohydrate derivative which is characterized by the presence of galacturonic acid units.

this assumption is shown in Fig. 7. The carbon dioxide-rate curve of the pectin ** is very similar in shape to that obtained for galacturonic acid (Fig. 2), and reaches a maximum at 208 mg. of carbon dioxide per gram of pectin. From this value, a factor of 4.8 * for converting carbon dioxide, formed from uronic acids, to the pectin extracted from cotton, is obtained. The pectin content of the cotton used in the present work may then be roughly estimated by multiplying 2.4 mg. (from the curves in Fig. 6) by 4.8, which gives a value of 11.5 mg. of pectin per gram or 1.15%. As is to be expected, this value is higher than previously reported values, obtained by isolation methods.[20, 21]

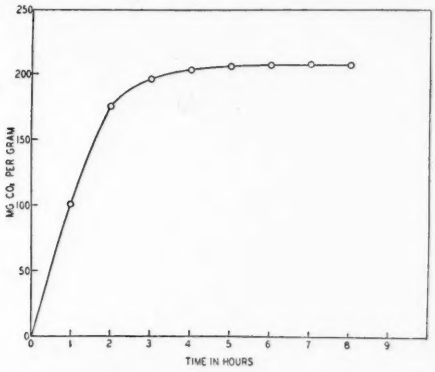


Fig. 7. Rate of evolution of carbon dioxide from a sample of pectin from cotton.

The uronic acid contents of a number of other cellulosic fibres were also determined. Table 2 shows the results obtained from decorticated ramie, retted flax, and purified samples of both. Purification was accomplished by treatment of the fibres with a boiling, 1% solution of sodium hydroxide for four hours by the methods described for cellulose. The data for the decorticated ramie and retted flax are similar to those obtained for dewaxed cotton, inasmuch as they show an initial, rapid evolution of carbon dioxide, which becomes slower but approximately constant after four hours. During the first four hours considerably more carbon dioxide was evolved by both ramie and flax than was evolved in the same period by cotton. The value for the amount of carbon dioxide evolved by the uronic acid groups, obtained by subtracting the value for the purified from that for the unpurified fibre, reaches a maximum after about four hours and then remains constant. An average of 10.4 and 10.2 mg. of carbon dioxide per gram of ramie and flax, respectively, was obtained.

** The pectin used in these experiments was obtained from the cotton by the well-known method of extraction with ammonium oxalate. A description of the preparation and properties of this pectin is being prepared for publication.

* This factor is valid only if it is assumed that the pectin has not been appreciably altered during removal from the fibre. Justification for the use of such a factor will depend on obtaining similar results on samples of pectin removed from cotton by several different methods. Work along this line is in progress.

Table 2

The Amount of Carbon Dioxide Evolved From the Uronic Acid Groups of Ramie and Flax Fibres.

Duration of Treatment	Ramie			Flax		
	Decorticated	Purified	Uronic acid—carbon dioxide	Retted	Purified	Uronic acid—carbon dioxide
hrs.	mg./gm.	mg./gm.	mg./gm.	mg./gm.	mg./gm.	mg./gm.
1	5.4	0.3	5.1	5.4	.3	5.1
2	8.5	.5	8.0	8.7	.7	8.0
3	10.1	.6	9.5	10.2	1.0	9.1
4	10.9	.7	10.2	11.2	1.4	9.8
5	11.4	1.0	10.3	11.7	1.6	10.1
6	11.9	1.4	10.5	12.2	1.9	10.3
7	12.0	1.7	10.3	12.5	2.3	10.2
8	12.4	2.0	10.4	12.8	2.6	10.2
9	12.7	2.3	10.4	13.1	3.0	10.1

The results obtained from three different samples of rayon are shown in Fig. 8. The curves for viscose and cuprammonium rayon are nearly identical with that for glucose. A sample of acetate rayon evolved carbon dioxide at a somewhat lower rate. However, if the data for the acetate rayon are calculated on the basis of milligrams of carbon dioxide per gram

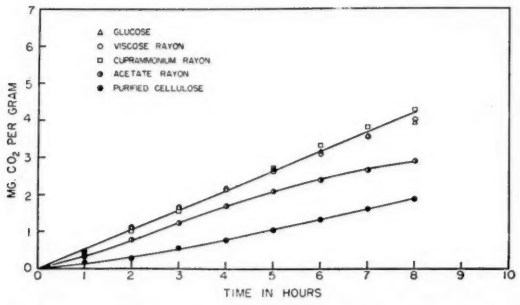


Fig. 8. Rate of evolution of carbon dioxide from samples of rayon, glucose and purified cotton.

of cellulose instead of cellulose acetate, the results are very similar to those for the viscose or cuprammonium rayon. The curves for these samples indicate that they are free of uronic acids.

A carbon dioxide-rate curve for purified cotton cellulose is included for comparison. It is of interest to note that the slope of this curve is quite different from that of glucose or the regenerated fibres.

References

1. K. V. Lefevre and B. Tollens. *Ber. deut. chem. Ges., 40,* 4513 (1907).

2. A. W. van der Haar. "Anleitung zum Nachweis, zur Trennung und Bestimmung der Monosaccharide und Aldehydesauren," Gebrüder Borntraeger, Berlin, p. 71 (1920).

3. D. R. Nanji, F. T. Paton and A. R. Ling. *J. Soc. Chem. Ind., 44,* 253T (1925).

4. W. H. Dore. *J. Am. Chem. Soc., 48,* 232 (1926).

5. R. B. McKinnis. *Ibid., 50,* 1911 (1928).

6. F. Ehrlich and F. Schubert. *Ber. deut. chem. Ges., 62,* 1974 (1929).

7. A. D. Dickson, H. Otterson and K. P. Link. *J. Am. Chem. Soc., 52,* 775 (1930).

8. C. M. Conrad. *Ibid., 53,* 1999 (1931).

9. G. Klein. "Handbuch der Pflanzenanalyse," Julius Springer, Vienna *3,* p. 121 (1932).

10. H. W. Buston. *Analyst, 57,* 207 (1932).

11. B. Burkhart, L. Baur and K. P. Link. *J. Biol. Chem., 104,* 171 (1934).

12. W. G. Campbell, E. L. Hirst and G. T. Young. *Nature, 142,* 912 (1938).

13. A. G. Norman. *Ibid., 143,* 284 (1939).

14. H. Colin and S. Lemayne. *Bull. Soc. Chim. Biol., 20,* 343 (1939).

15. W. F. Hillebrand and G. E. F. Lundell. "Applied Inorganic Analysis," John Wiley & Sons, p. 623 (1929).

16. Report of the Committee of the Division of Cellulose Chemistry of the American Chemical Society. *J. Ind. Eng. Chem., 15,* 748 (1923).

17. A. B. Corey and H. L. Grey. *Ibid., 16,* 853, 1130 (1924).

18. R. K. Worner and R. T. Mease. *N. B. S. J. Rsch., 21,* 609 (1938).

19. American Chemical Society Committee on Nomenclature of Pectin of the Agricultural Food Division. Definitions. *J. Am. Chem. Soc., 49,* Proc. 37 (1927).

20. S. A. Harris and H. J. Thompson. *Contributions from Boyce Thompson Institute, 9,* 1 (1937).

21. J. T. Marsh and F. C. Wood. "An Introduction to the Chemistry of Cellulose," p. 12 (1938). Chapman and Hall, London.

Twist Determination in Single Yarns

By H. R. BELLINSON*

Summary

Discussion of the method of determining twist in single yarns by the method of untwisting and retwisting to the same twist in the opposite direction, and description of an instrument, to be used with a twist counter, which indicates the end-point by measuring length. The instrument consists of a pendulum operating in conjunction with a photronic cell, and the end-point is signaled by a buzzer. Such twist determinations become semi-automatic when done on a motor-driven twist counter.

Twist in Single Yarns

There are two approved[1] methods for determining the twist of single yarns.

> 1. The yarn shall be gripped in a twist counter with clamps set not too far apart (4 in. for wool). One clamp shall be rotated until the twist is removed as indicated by passing a sharp pointed needle from clamp to clamp.

There can be no doubt that this procedure actually measures twist. But the separation between clamps must not exceed the staple length, for if it does, the needle, in passing from clamp to clamp, will come out at the side, and "break" the untwisted yarn. For cotton, the clamp separation must be ½ to ¾ in., and consequently the determination becomes awkward to perform, the length of yarn in the twist counter becomes difficult to determine precisely, and the average of 15 to 20 successive measurements are required to attain the value that might be obtained in a single 10" specimen. Perhaps because of these very difficulties, this procedure is not recommended for short staple yarn (cotton, rayon staple), but instead:

> 2. The turns per inch of twist shall be determined on any standard single yarn twist tester by employing the principle of first taking the twist out of a given length of yarn and then retwisting in the opposite direction until the same amount of twist is put back, dividing the result by twice the distance between grips to obtain the twist per inch.

Twist is here determined by untwisting the yarn until all twist is removed, and retwisting in the opposite direction until the same amount is

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reinserted. To do this as directed, the twist must be known, and if the twist is known, there is no need to perform a twist determination.

There is no direct method of determining when the yarn has been retwisted in the opposite direction to the same number of turns. But properties of the yarn which are functions of twist may be used to determine this point, if the assumptions are made that:

(a) There is no permanent set in the fibres.
(b) The length has not changed in the twisting operations.

For example, the angle made by the fibres with the axis of the yarn is such a function of twist. Therefore, the number of turns required to untwist and retwist in the opposite direction until the same angle is assumed by the fibres may be considered to be twice the total number of turns in the specimen. However, Schwarz [2, 3] has shown that if the apparatus for measuring this angle is available, it is not necessary to use a twist counter.

Another property of yarns which is a function of twist is the length (or contraction). In utilizing the property of contraction, the initial length of the yarn is measured, the yarn is untwisted (with elongation), and retwisted in the opposite direction (with contraction) until the initial length is reestablished. Length must be measured under the same tension at the beginning and end of the determination, and there must be no tension on the specimen while untwisted if no permanent stretch is to be introduced.

An instrument to utilize this property of contraction is presented in this paper.

Pendulum Method of Measuring Change in Length

One method of measuring the change of length in a yarn as it is twisted is by means of a pendulum swinging in an arc perpendicular to the axis of the yarn. The clamps of the twist counter are adjusted to provide a slight amount of slack in the yarn. The pendulum is placed (at the center of the specimen) so that it is deflected by the yarn. This deflection introduces a tension, and is a measure of the length. As the yarn is untwisted and elongates, the pendulum is no longer deflected, so that no tension is applied to the yarn in its weakened condition. As the yarn is retwisted and contracts, the pendulum is again deflected, and when it returns to its initial deflection (as might be indicated by a pointer) the yarn has returned to its initial length as measured under the initial tension.

Schwarz,[4] in developing this technique, utilized an electrical method to indicate the return of the pendulum to its initial deflection. In this instrument, the return of the pendulum to its initial deflection was indicated by the sound of a buzzer. The instrument could also be used in conjunction with a motor-driven twist counter, in which case the reestablishment of the initial deflection stopped the motor, so that the determination became semi-automatic. The operation of the buzzer and the motor was determined by a capacitance effect between a metal plate attached to the top of the pendulum and another fixed plate. This method of determining a desired deflection eliminated the objections inherent in a switch-type indicator, but introduced another difficulty in that the action of the device was altered by humidity changes in the air gap between the two plates, so that the device had to be used in a constant humidity atmosphere. This difficulty

has been eliminated by redesigning the instrument so that the desired deflection is indicated by a photronic cell.

Description of Pendulum-Photronic Cell Indicator

The new instrument is illustrated in Fig. 1, and the operating parts shown schematically in Fig. 2. There is a projection lamp on one side of

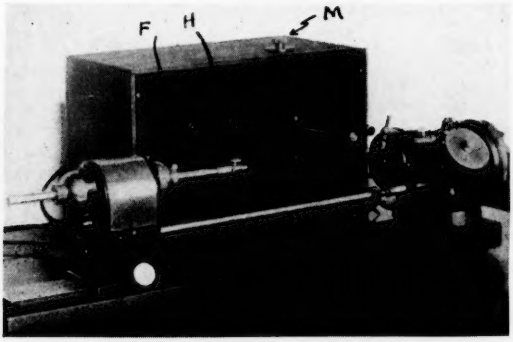

FIG. 1

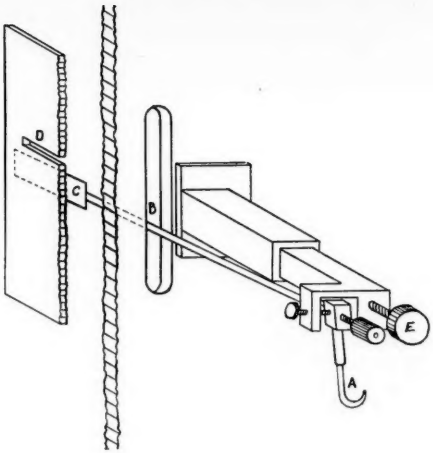

FIG. 2

the slit D, and a photronic cell on the other side. When the vane C of the pendulum covers the slit, no light strikes the photronic cell. When the vane falls below the slit, light strikes the cell, which generates sufficient current

to operate relays, and these control the current which operates a buzzer or a motor or both.

Switch F turns the entire apparatus on and off. Switch H reverses the effect of the relays (see wiring diagram, Fig. 3). When switch H is down, the buzzer and motor will operate if the slit is open, and stop as soon as the vane closes the slit. When switch H is up, the buzzer and motor operate while the slit is closed, but stop as soon as the vane falls below the slit and lets the light strike the photronic cell.

The knob E (Fig. 2) moves the pivot, and thus the entire pendulum, in and out, and is used in adjusting the initial deflection as described below.

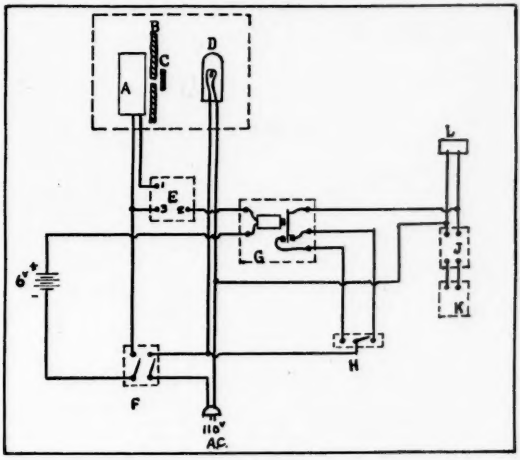

FIG. 3

(A) Weston Photronic Cell, Model 594; (B) Slit; (C) Pendulum Vane; (D) Projection Lamp, G. E. 50w. 115v.; (E) Weston D.C. Miniature Relay, Model 634; (F) Double-Pole Single-Throw Switch; (G) Power Relay, 5a at 110v.; (H) Single-Pole Double-Throw Switch; (J) Bell-Ringing Transformer; (K) Buzzer; (L) Outlet for Motor, Indicator, etc.

Twist Determination

At the start of a determination, the knob E is turned to move the pendulum in toward the panel, so clearing the space between the two clamps of the twist counter. A specimen is placed in the clamps, and the length determined by means of the scale on the sliding clamp. Then the sliding clamp is moved in 0.1 in., to provide slack in the yarn, and locked in this position.

With switch H down, the buzzer will now be operating. Knob E is turned to bring the pendulum out. As the pin A presses against the yarn, vane C will be lifted toward the slit. The initial deflection is obtained by turning the knob until the slit is just covered, as indicated by the silence of the buzzer. At this point, neither the buzzer nor the motor will operate. But as soon as a few turns are removed from the yarn manually, the vane will drop below the slit and both buzzer and motor will operate.

While the yarn is in an untwisted state, it is supported by the hook in the bottom of the pin so that it cannot fall away from the pin. At the same time, the pendulum is supported by the bottom of the slot B, so that there is no tension on the yarn.

As the yarn is retwisted in the opposite direction (which means that the rotating clamp continues to turn in the same direction even after all twist has been removed) the specimen will contract and push back the pin A. This lifts the vane towards the slit. When the yarn reaches its initial length, the vane will have just covered the slit. This being also the initial deflection, the pendulum will exert the same tension on the yarn as it did at the start of the determination.

If the determination is performed with the aid of a motor-driven twist counter, the re-establishment of the initial length will cause the motor to stop. If the determination is performed manually, the re-establishment of initial length will be signaled by the stopping of the buzzer.

Sensitivity

The slit C is $\frac{1}{16}$ in. in width. Consequently, a motion of this magnitude in the vane makes the difference between a completely open slit and a completely closed slit. Thus, the number of turns required in the yarn to move the vane $\frac{1}{16}$ of an inch indicates the sensitivity of this method of measuring twist.

The center of the vane is 6″ from the pivot of the pendulum; the point on the pin at which the yarn touches the pendulum is 1.25″ below the pivot. Therefore, a motion of this point on the pin of

$$\frac{1}{16} \times \frac{1.25}{6} = 0.0130''$$

is sufficient to open or close the slit.

Consider Fig. 4. This shows (exaggerated for clarity) a 10″ specimen of yarn between clamps fixed at 9.9″ separation, with the pin A pressing

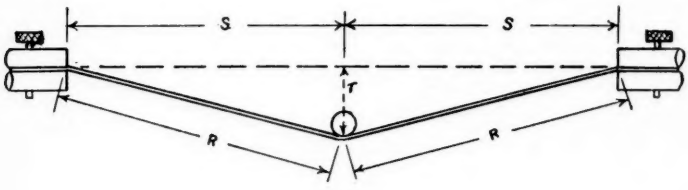

FIG. 4

the yarn out at the center. The length R, being half the specimen length, is 5.00″. The length S, being half the clamp separation, is 4.95″. The length T must therefore be

$$(5.00)^2 - (4.95)^2 = 0.7053''$$

This is the distance by which the pin pushes the yarn out of the straight line between clamps. At this position, the slit will be closed, since this represents the initial adjustment.

If the pin moves 0.0130″ further out, and thus opens the slit, the distance T becomes 0.7183″, the length S remains 4.95″, and the length R must become

$$(4.95)^2 + (0.7183)^2 = 5.0018''$$

So that when the length of the yarn becomes 10.0036″, or the yarn has elongated by .0036″, the slit will have opened.

Measurements made * on 40/1 cotton yarn show that in the vicinity of normal twist, the elongation per turn of twist is 0.002″. Consequently, two turns of twist will suffice to open or close the slit. Since the determination is performed on a 10″ specimen, the sensitivity of the apparatus is 0.2 turns per inch. For coarser yarns, where the elongation per turn is greater, even fewer turns will be required to open or close the slit.

Tension

The tension applied on the yarn by the pin is a function only of the design of the pendulum and of its deflection. It is desirable that, throughout a series of determinations on specimens of the same yarn, the initial tension remain the same. This is assured in the design of the instrument.

The initial deflection is achieved by bringing the vane up until it has just closed the slit. Since the slit remains fixed throughout a series of determinations, this initial deflection, and therefore the initial tension, remains constant.

However, it may be desirable to vary the initial tension for different yarns. Thus, a specimen taken from a fabric would require a greater tension than an uncrimped yarn taken from a spool. The tension may be varied by changing the design of the pendulum, which requires in practice the readjustment of the counterweight on the pendulum. However, this is an awkward and coarse adjustment. A simpler and finer adjustment is provided if the slit itself is made adjustable. In the present instrument, the slit was put in a sliding brass plate, and this plate can be moved up and down by means of the knob M (Fig. 1).

In use, the knob M is turned only before a series of determinations are begun, and then only if it seems necessary to change the initial tension. Throughout a series of determinations the slit remains fixed, and thus the initial tension on each successive specimen remains constant.

NOTE: *This instrument has been in use at the M. I. T. Textile Laboratory, both for twist determinations and laboratory instruction, throughout the past year.*

References

1. A. S. T. M. Standards on Textile Materials, 1938.

2. E. R. Schwarz. Introduction to Micro-Analysis of Yarn Twist. *J. T. I., 24,* T105, 1933.

3. J. T. Killian and E. R. Schwarz. Note on Application of Twist Formulae. *J. T. I., 27,* T237, 1936.

4. E. R. Schwarz. Twist Measurements in Single Yarns. *Text. Rsch., 8,* 157, 1938.

* Measurements made in M. I. T. Textile Laboratory by H. Hindman and E. R. Kaswell.

The Moisture Regain of Acetylated Silk Fibroin

By EDWARD CARR*

A Textile Foundation Publication

Summary

Moisture regain measurements have been made at 25° C. and 79.3% relative humidity on non-acetylated and acetylated fibroin.

The equilibrium moisture content of acetylated fibroin is slightly lower than that of non-acetylated fibroin and varies with the degree of acetylation.

In the case of fibres acetylated by the action of acetic anhydride it is shown that the decrease in moisture content is not attributable to the action of liberated acetic acid.

Introduction

IN continuation of the researches projected in this laboratory[1] on the relationship between the structure and properties of silk fibroin data have been obtained on the effect of acetylation on the moisture regain of degummed silk fibres.

Many of the properties of fibres, such as the electrical properties, tensile strength, elasticity, diameter are functions of the equilibrium moisture content. Walker[2] has proposed a theory to explain the dependence of the electrical properties of textiles upon their moisture absorbing properties, basing his argument mainly on data referring to cellulose.

In the case of protein fibres the problem of the relationship between structure and properties is complicated by the presence of a variety of types of atomic grouping. The types of atomic grouping which have been shown to be present in a free state in the silk fibre are NH_2, COOH and the tyrosine hydroxyl group. On acetylating silk fibroin, however, a degree of acetylation is attained which corresponds to considerably more than the known quantity of amino and hydroxyl groups in the protein.[1] This observation points to the possibility of the presence of groups, in addition to the known acetylatable groups, which may influence the moisture affinity of the fibre.

Data showing that acetylation improves the electrical insulating properties of fibroin have been published by New,[4] but his paper gives no data on the degree of acetylation or on the moisture affinity of the acetylated fibres.

The experimental part which follows presents data obtained on measuring the equilibrium moisture content of acetylated fibroin.

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Experimental

Several five gram skeins of raw Japanese white silk * were degummed by soaking for two hours in a 2% solution of neutral olive oil soap at 90°–100° C. The skeins were then squeezed to remove much of the soap solution and were repeatedly rinsed in fresh quantities of warm water until apparently free from soap. The remaining soap was removed by digesting the skeins with frequent agitation in distilled water at 90–100° for six separate periods of 30 min., with wringing of the skeins between changes of water. The moist fibres were washed with acetone to render them fluffy, and allowed to dry by evaporation at room temperature. The fibres were then dried at 105° C. and stored in a desiccator over anhydrous calcium chloride.

Portions of the degummed fibres were acetylated either by means of the ketene-containing gas obtained on pyrolyzing acetone,[1] or by means of acetic anhydride,[1] or otherwise treated according to the following schedule:

I. Non-acetylated degummed fibres.

II. Fbres acetylated by means of CP acetic anhydride:
   a. 30 min. at 100° C.; 4.1% CH_3CO.
   b. 30 min. at 125° C.; 7.4% CH_3CO.

III. Fibres acetylated by the action of ketene contained in acetone pyrolysis gas:
   a. 6.5 hours at 100° C.; 4.8% CH_3CO.
   b. 8.5 hours at 100° C.; 6.8% CH_3CO.

IV. Fibres treated with 99% acetic acid at 100° C. for 30 min. These fibres were used for the purpose of determining whether the action of the acetic acid normally generated by the acetylating action of acetic anhydride could account for a change in moisture regain.

All of the fibres were extracted for four hours with acetone. Thus the acetylated and acetic acid-treated fibres differed from the original fibres only in the effect produced by the acetylation treatment.

The acetyl content of the acetylated fibres was determined by the method described in previous papers.[1]

The regain data were obtained at a single condition of humidity and temperature since it was desired to determine only the magnitude of the effect of acetylation on the moisture affinity. An atmosphere of known humidity was maintained in a desiccator by means of a saturated solution of ammonium chloride at 25° ± 0.2° C. The humidity conditions established by this means have been determined by Edgar and Swan,[5] and for the neighborhood at 25° are recorded in Table 1:

TABLE 1

Humidity Conditions over Saturated Ammonium Chloride

t° C.	Relative Humidity %
20	79.2
25	79.3
30	79.5

* Furnished by Cheney Brothers, South Manchester, Conn.

This particular humidity condition was chosen because of its constancy, and because of the fact that its high value leads to relatively large regains. This last consideration was important since it was necessary to work with small samples of fibres.

Regain measurements were carried out in the following manner: Samples of non-acetylated or treated fibres were prepared in the form of short cylindrical bundles of such size as to fit into weighing bottles of approximately 15 ml. capacity. The bottle containing the sample, and the ground glass stopper, were dried separately at 105° C. in a silk-conditioning oven for periods of time up to 2 hours. The stopper was then quickly put into place, the bottle and contents brought to room temperature in a desiccator, and the bottle weighed in equilibrium with room atmosphere. Drying and weighing were repeated until the desired constancy of weight was reached. The open bottle containing the fibres and the lid were then exposed to the humid atmosphere for successive periods of several hours. At intervals the closed bottle of fibres was weighed.

Experience demonstrated that a bottle containing fibres could be either dried or humidified to a weight constant to within 0.0001 g. In the case of drying no particular difficulty was encountered in obtaining such constancy. In the case of humidification, however, it was necessary to have the ground glass lid of the humidifying desiccator well sealed with vaseline in order to eliminate any connection with the outside atmosphere. Moreover, it was necessary to cover the weighing bottle quickly after opening the desiccator. By tilting the stopper of the weighing bottle on edge in the mouth of the bottle a minimum of time was required to tip the lid into place after opening the desiccator.

In making all weighings, the sensibility of the balance and the zero of swing were taken into consideration which latter was determined before and after each weighing.

A typical series of weights obtained during the course of drying and humidifying a sample is given in Table 2. The results for all the samples are given in Table 3.

TABLE 2

Determination of Dry and Humidified Weights of a Sample of Fibres (Sample II, b, 1, of Table 3)

Drying		Humidification	
Time, Hrs.	Fibre, Wt.	Time, Hrs.	Fibre, Wt.
0	.4757	0	.4629
1	.4640	19	.4986
1	.4635	52	.5009
1	.4633	20	.5017
1	.4631	5	.5019
1	.4629	24	.5024
1	.4629	19	.5023
1	.4630	24	.5024
1	.4629		

TABLE 3

Moisture Regain of Fibres at 25° C.
Relative Humidity 79.3%

Acetylating Agent	Sample No.	Weight		Regain % Acetylated basis	Fibroin basis
		Dry	Moist		
I	1	.6541	.7186		9.86
None	2	.5810	.6382		9.84
	3	.5419	.5952		9.84
					Av. 9.85
II					
Acetic Anhydride	1	.6693	.7305	9.14	
a. 4.1% CH_3CO	2	.6304	.6882	9.17	
	3	.6911	.7545	9.18	
				Av. 9.16	9.55
b. 7.4% CH_3CO	1	.4629	.5024	8.53	
	2	.5431	.5892	8.48	
	3	.5002	.5432	8.59	
				Av. 8.53	9.21
III	1	.5631	.6129	8.85	
Ketene	2	.5112	.5564	8.84	
a. 4.8% CH_3CO	3	.4988	.5431	8.88	
				Av. 8.86	9.31
b. 6.7% CH_3CO	1	.6610	.7169	8.46	
	2	.6139	.6655	8.40	
	3	.6017	.6525	8.45	
				Av. 8.44	9.05
IV	1	.7015	.7702	9.79	
Acetic Acid 99%	2	.6026	.6617	9.81	
0.2% CH_3CO	3	.6444	.7077	9.83	
				Av. 9.81	

A number of humidified samples were allowed to lose moisture in a desiccator and were again exposed to the humid atmosphere. It was found that the value for the moist weight could be restored to within 0.0001 g.

The reproducibility between determinations on separate samples taken from a given lot of fibres shows a variation greater than that corresponding to the accuracy of determining individual weights. This variation probably reflects the degree of uniformity of a given lot of fibres.

In order to determine whether the observed decreases in regain are real or are merely a consequence of an increase in the weight of the fibres

due to the attachment of acetyl groups, it is necessary to calculate the results to the basis of non-acetylated fibroin contained in the acetylated product. It was found that fibroin treated with either pure acetic anhydride or with ketene shows an increase in weight which corresponds fairly closely to the acetyl content, as shown in Table 4. The percentage gain in weight is calculated on the basis of the dry weight of the acetylated fibres after extraction with acetone.

TABLE 4

Change in Weight of Fibroin due to Acetylation

Acetylating Agent	Temp. t° C.	Time hrs.	Wt. gain %	% CH_3CO
Acetic Anhydride	100	0.5	3.9	4.1
			4.0	4.2
	125	0.5	7.0	7.3
			7.1	7.5
Ketene	100	5	4.2	4.3
		8	6.9	7.1
Acetic Acid 99%	100	0.5	loss of 1%	0.2

These observations may be taken to indicate that acetic anhydride has practically no dissolving action on fibroin and that the action of the acetylating agents used is the substitution of CH_3CO for H.

On recalculating the moisture regains on the basis of a quantity of fibre exclusive of the weight of acetyl groups present there are obtained the values in the last column of Table 3. These recalculated values are to be compared with those found for non-acetylated fibroin (Samples I). The differences, though small, are greater than the errors of measurement and lead to the conclusion that an actual decrease in moisture regain is effected by acetylation.

The regain of fibres treated with 99% acetic acid is practically the same as that of untreated fibres, although acetic acid exerts a dissolving action. The slight decrease in moisture regain found in the case of acetic acid treated fibres shows that the larger decrease found in the case of acetylated fibres is not due to the action of acetic acid.

References

1. Kise and Carr. *Text. Rsch., 7,* 103 (1936); Carr. *Ibid., 8,* 125 (1938).

2. Walker. *Text. Rsch., 7,* 229, 289 (1937).

3. Meunier and Rey. *Compt. rend., 184,* 285 (1927); Czarnetsky and Schmidt. *J. Biol. Chem., 105,* 301 (1934); Kise. *Text. Rsch., 9,* 401 (1935).

4. New. *Elec. Comm., 14,* 213 (1936).

5. Edgar and Swan. *J. Am. Chem. Soc., 44,* 570 (1922); Int. Crit. Tables, I, 68 (1926).

Abstracts

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E. R. Schwarz, Chm., Dr. E. J. Saxl, C. H. Clark.

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I. Fibres (Synthetic and Natural) and Fibre Analysis

Jute: Chemistry in the Processing of. Herbert L. Parsons. *Text. Mfr.*, Sept. 1939, P. 417–8; Oct., P. 426–9.

Also includes abstracts of papers at the recent British Association Meeting in Dundee. (C)

Wool and Related Fibres: Action of Light on. II. Experimental. Speakman and McMahon. *N. Z. J. Science and Tech.*, July 1939, P. 31–46B.

The titration curves of root and tip wool, taken from staples selected from the side and shoulder of a New Zealand Romney fleece, have been determined with a view to interpreting the decomposition undergone by wool fibres on exposure to sunlight during growth. Since the acid-titration curves of intact (root) and exposed (tip) wools are practically identical, there can be no doubt that the main peptide chains of animal fibres are not hydrolyzed under the influence of sunlight and air. The disulphide bonds, on the other hand, are severely attacked, undergoing similar changes to the main reaction taking place in caustic-soda solution. Aldehyde and sulphydryl groups are developed, the latter being responsible for the increased affinity of exposed (tip) wool for alkali above pH 7. The titration curve of root wool may be regarded as having general validity for intact wool keratin, and has the importance of showing that wool,

besides possessing an isoelectric range, combines with little alkali below pH 10, in agreement with the salt linkage hypothesis.

The changed dyeing reactions of wools exposed to light are due, in part, to factors of a purely chemical nature, and endeavors were made to eliminate the sulphydryl groups produced as a result of irradiation. Attempts to oxidize these groups failed on account of the stereochemical factors which affect their reactivity. Qualitative experiments indicated that condensation reactions could be brought about, but an attempt to modify the titration curve of tip wool by treatment with iodoacetic acid failed owing to incomplete reaction. Treatment with iodine destroyed the ·SH groups, but side reactions with other portions of the wool molecule rendered the titration curve of the treated wool incapable of explanation on the data available. (C)

WOOL: BASE-COMBINING CAPACITY OF. Milton Harris and Henry A. Rutherford. *Text. Rsch.*, Vol. 9, P. 245–52; *Am. Dye. Rptr.*, May 29, 1939, P. 293–6; *N. B. S. J. Rsch.*, May 1939, P. 535–42.

It is shown that the failure of wool to reach equilibrium with alkaline solutions under the conditions of titration experiments is due to the reaction of base with the disulfide groups of the cystine. The results indicate that the extent of this reaction can be determined. The data also afford confirmation of the earlier observation that the alkali degradation of the cystine in wool involves the loss of only one sulfur atom from each cystine residue. Determination of the amount of base absorbed from solutions of various concentrations indicates that a limiting amount of about 0.7 millimole per gram of wool is reached above concentrations of about 0.2 N sodium hydroxide. Because of discrepancies in the data obtained at concentrations greater than 0.3 N, it is suggested that this value be considered for the present as tentative. (C)

II. YARNS AND FABRICS

PROCESSING UNRETTED FLAX. S. A. G. Caldwell. *Text. Mfr.*, April 1939, P. 162–3, 168.

A review of the developments in extracting flax without retting and the processing of the natural flax. (C)

"RAYOLANDA" X AND "RAYOLANDA" W.D. H. A. Thomas. *Text. Mfr.*, June 1939, P. 270–2.

Abstract of a paper at recent annual conference of The Textile Institute at Bath, Eng. (C)

RAYON CRÊPE RESEARCH. V. DETERMINATION OF THE EFFECTS OF VARIATIONS IN THE MANUFACTURE OF RAYON CRÊPE DRESS FABRICS. *Am. Dye. Rptr.*, May 1, 1939, P. 226–54.

The Rayon Crêpe Research was conducted jointly by the Throwsters Research Institute, Inc., and the A. A. T. C. C. The work in each part of this program is so closely related that the reader is cautioned against drawing conclusions wholly on the basis of the results of the individual parts. The Rayon Crêpe Research Committee will correlate all of the data and publish their conclusions in the final issue. (C)

RAYON DEVELOPMENTS: TRENDS IN MAN-MADE FIBRE PRODUCTION. Harold DeW. Smith. *Canadian Text. J.*, May 26, 1939, P. 32–6.

Address delivered in March 1939 before the Textile Society of Canada (Eastern Section). (C)

RAYON FABRICS: ANALYSIS OF. I. WEFT-KNITTED FABRICS. J. B. Lancashire. *Silk & Rayon*, Mar. 1939, P. 206, 208, 212. (C)

RAYON OUT OF THE MELTING POT. INTERESTING FACTS ABOUT NYLON—THE NEW FUSED FIBRE. Anon. *Silk & Rayon*, Mar. 1939, P. 200, 202, 204. (C)

RAYON STAPLE FIBRES: SURVEY OF LEADING AMERICAN. H. R. Mauersberger. *Rayon Tex. Mo.*, April 1939, P. 57–9.

The author gives deniers, lengths, makers, processes and brand names. (C)

RUBBER AS A TEXTILE AUXILIARY. Julius Warwick. *Text. Col.*, April 1939, P. 227–9, 276.

A review of some of the more recent discoveries and more novel proposals relating to the employment of this hydrocarbon in relation to textiles. (C)

RUBBERIZING OF WOOL AND OTHER FIBRES, YARNS OR FABRICS. *Text. Mfr.*, April 1939, P. 173.

Abstract of a lecture describing a patented discovery of the British Wool Industries Research Association and the British Rubber Producers Research Association for rubberizing wool, and also indicating its applications. (C)

RUBBER: RECENT DEVELOPMENTS IN DEPOSITION OF—ON TO TEXTILE FIBRES. C. M. Blow. *J. Soc. Dyers Col.*, July 1939, P. 337–44.

A summary and discussion of the results to date of this paper of research of the British Wool Industries Association and the British Rubber Producers Research Association. A process for rubberizing wool has been evolved, consisting in the deposition or precipitation of rubber on to the fibres from dilute rubber latex, the rubber being taken up in a manner analogous to a dye with exhaustion of the dispersion in the bath. In order to achieve this result, the natural latex is modified by addition of "cationic" soap compounds so that the charge on the particles is reversed. Normally 5–15% of rubber by weight is applied to the textile, although in some instances a higher percentage may be advantageous. Yarns can be processed in hank or on cheese and it is possible also to apply the treatment to fabrics in an analogous manner. It should be pointed out, however, that the treatment of yarn makes possible the production of fabrics which will show up the advantages of rubberizing to the fullest extent. Summarizing the properties of rubberized wool, it may be stated that the rubber binds the fibres together and prevents their movement. Up to the present, this property has application to increase the strength of soft low-twist yarns while preserving to a large extent the handle and fullness, to prevent the "balling-up" and shedding of fibres in soft fabrics, and to increase wear gener-

ally. It is not anticipated that the behavior of rubberized material will present any insuperable problems in dyeing and finishing. (C)

RUVIS—ELASTIC YARN. Fellotti. *Silk & Rayon*, Jan. 1939, P. 74.

Results of comparative tests of Ruvis and cut thread are given. (C)

SHODDY INDUSTRY: NEW DEVELOPMENTS. G. Nitschke. *Monats. f. Text. Ind.*, 1939, V. 54, P. 23–6; abs. in *J. T. I.*, April 1939, P. A236.

Methods are discussed for treating re-manufactured wool containing various types of staple fibre, especially the carbonizing, stripping and dyeing processes. Special difficulties arise in the presence of acetate staple fibre, mention being made of processes developed for its carbonizing (see *J. T. I.*, 1938, P. A668) and dyeing (*ibid.*, P. A745). (C)

SHUTTLE VELOCITY AND PICKING CAMS IN THEORY AND PRACTICE. J. Anderton. *Text. Mfr.*, June 1939, P. 251–2.

A challenge from the view of practical experience to some of the conclusions of the students of loom picking dynamics. (C)

SIZING AND DESIZING: USE OF ENZYMATIC TEXTILE AGENTS FOR. H. J. Henk. *Deut. Wollen-Gewerbe*, 1938, V. 70, P. 1591; abs. in *J. T. I.*, April 1939, P. A233.

The mechanism of enzyme action is discussed. The advantages to be obtained by using specific enzymes, maintaining suitable pH and temperature conditions, are stressed. (C)

SLASHER INSTRUMENTATION: SIZE COOKING; SIZE STORAGE; QUETSCH PAN; SLASHER CANS. Reginald Trautschold. *Rayon Tex. Mo.*, Jan. 1939, P. 76.

SOLVENT EXTRACTION OF WOOL PIECE GOODS. Roland E. Derby. *Canadian Text. J.*, July 7, 1939, P. 37–8.

A new process for dry cleaning or solvent extraction of wool piece goods as they come from the loom, employing specially designed equipment and the use of trichlorethylene, is described in this address before the Canadian A. T. C. C., Ontario Section, June 1939. (C)

SPINNING RAYON STAPLE. J. L. Brannan. *Text. Wld.*, Mar. 1939, P. 67.

Speeds and settings which result in good quality yarn are described. (C)

STAPLE FIBRE: MANUFACTURE OF—BY THE KOHORN SYSTEM. H. H. Von Kohorn. *Rayon Tex. Mo.*, April 1939, P. 60–1. (C)

STATIC ELECTRICITY IN TEXTILE MANUFACTURING. W. C. Glass. *Text. Age*, Jan. 1939, P. 56–8. (C)

SURGICAL WADDING. O. Eichler. *Mell. Textilber.*, 1939, No. 6, P. 429–32.

The value of wetting agents is still a subject of discussion among manufacturers of surgical cotton, some of whom, as suggested by Kind, reject the addition of Turkey red oil and similar products to the kier boil.

Bleaching is mostly carried out by the circulation of sodium hypochlorite (calcium hypochlorite is rarely used for the purpose), and the material is afterwards soured with sulphuric acid. The crunching handle is produced by treatment with a hot solution of soap and very dilute sulphuric acid; soaping is carried out in the bleaching tub, while souring is effected in washing hollanders simultaneously with the blueing. It is very important to ensure that the sulphuric acid solution is not rinsed out of the wadding, but is removed by treatment in a hydroextractor, being finally dried in stoves at 60 to 80° C. The material is then allowed to lie for some time so as to recover its normal moisture content and is afterwards carded to form laps. It will be understood that the material cannot have a neutral reaction and contain residual acid. The German Pharmacopoeia prescribes the permissible acid content. The actual cause of the crunching handle is still unknown. The article describes in detail the various methods of examination of surgical wadding. (C)

TAKE-UP DUE TO TWIST IN RAYON AND SILK YARNS. Harry A. Mereness. *Rayon Tex. Mo.*, April 1939, P. 55–6.

The author discusses the result of attempts to reconcile various divergent published data on the take-up due to twist for regenerated rayon yarns and 13/15 real silk yarns, together with some new data on the take-up on 20/22 silk yarns. (C)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

LABORATORY: HOW FAR DOES THE—CONTROL THE DYEHOUSE OR PRINTING SHOP? *J. Soc. Dyers Col.*, Sept. 1939, P. 437–44.

A symposium presenting papers by L. Thompson, "To what extent can the dyehouse be controlled by the laboratory?"; C. C. Wilcock, "The functions of a rayon yarn dyehouse laboratory"; F. Crompton, "Laboratory methods as aids to factory production." (C)

PRINTING ANILINE BLACK. J. Wakelin. *Canadian Text. J.*, Sept. 1, 1939, P. 29–30.

New methods of printing aniline black on cottons and acetate-viscose mixtures. (C)

PRINTING AND DYEING: USE OF CONDENSATION PRODUCTS OF FORMALDEHYDE WITH PHENOLS AND AMINES AS FIXING AGENTS IN. L. Baumann, G. Thesmar, S. M. Jones and J. Demant. Sealed Communication No. 2211 of Nov. 13, 1912. *Bull. Soc. Ind. Mulhouse*, 1939, V. 105, P. 190–5; abs. in *J. Soc. Dyers Col.*, Sept. 1939, P. 472.

A phenol-formaldehyde condensation product had already been used as a fixing agent for acid and basic dyes, but its applications were limited by its insolubility in water. This difficulty was overcome, however, by incorporating the components in the printing paste so that, on steaming, condensation and fixation of the color occur simultaneously with formation of vivid prints of good fastness to soap. For this purpose, resorcinol was the most satisfactory phenol, since it does not condense with formaldehyde in the cold, but does so very rapidly at about 100° C. Equally good results

are obtained by using formaldehyde-bisulphite compound. Printing pastes containing resorcinol and hexamethylenetetramine give similar results. A. Musculus confirms the above. (C)

SANFORIZING: MECHANICS OF. J. Girvin Cluett. *Am. Dye. Rptr.*, June 26, 1939, P. 343–7.

Paper presented at meeting, Southeastern Section, A. A. T. C. C., Feb. 18, 1939. (C)

SHRINKPROOFING WOOL: RECENT DEVELOPMENTS IN METHODS FOR. B. A. Harold. *Am. Dye. Rptr.*, Nov. 27, 1939, P. 683–5, 704. (C)

SILK FIBROIN: DYEING PROPERTIES. Edna C. Hoffman and Pauline B. Mack. *J. Phys. Chem.*, 1939, V. 43, P. 647–62.

A theoretical study has been made of the dyeing properties of a group of acid and of basic dyes, comprising two azo dyes and five triphenylmethane dyes, when applied to silk fibroin (degummed crêpe). The effect of temperature, time, concentration and initial pH on the amount of dye taken up by a unit weight of fibroin and the changes of H-ion concentration that take place were investigated. Changes in the temperature of the dye bath and of the time of immersion had marked effects on the amount of each dye taken up but the effect was not uniform. Equilibrium was reached for all the dyes in 8 hours at 25° C. The reaction conformed to Freundlich's adsorption isotherm. Changes of pH with change in concentration of dye are explained on the basis of hydrolysis of the dye. Changes of pH during dyeing, found to be independent of the amount of dye taken up by the silk, and changes brought about in baths of different initial pH values, are discussed. (C)

SILK VELVET: FINISHING. A. Effenberger. *Mell. Textilber., English Ed.*, 1939, V. 20, P. 31–2. (C)

SODIUM HEXAMETAPHOSPHATE: ELIMINATION OF CALCIUM CARBONATE DEPOSITS FROM INDUSTRIAL WATERS BY "THRESHOLD TREATMENT" WITH. O. Rice and E. P. Partridge. *Ind. Eng. Chem.*, 1939, V. 31, P. 58–63. (C)

SPONTANEOUS IGNITION OF SODIUM HYDROSULPHITE. K. Gaertner. *Chem. Ztg.*, 1939, V. 63, P. 237–8; abs. in *J. Soc. Dyers Col.*, Sept. 1939, P. 459.

Anhydrous sodium hydrosulphite is very sensitive to heat and moisture. Thus, in presence of about 10% moisture sufficient heat is developed to produce spontaneous ignition. Three fires on ships have already been attributed to sodium hydrosulphite, and every precaution should be exercised in packing and transporting it. (C)

STAPLE FIBRE: ALKALI TREATMENT. C. H. Fischer. *Zellwolle*, 1939, V. 5, P. 8–10, 46–7; abs. in *J. T. I.*, May 1939, P. A321.

Staple fibres, especially cuprammonium fibres, and yarns and fabrics made from them are treated with caustic soda of less than 10° Bé to increase affinity for dyes, increase the fibre curl, facilitate level dyeing and the removal of oil sizes, modify crêpe characters, close up, *e.g.*, knitted

stitch structures, reduce lustre, etc. Suitable conditions of treatment for the production of such effects are described and data showing improvements in yarn strength and extensibility are given. In the mercerization of staple fibre-cotton mixtures, a wetting agent of high activity should be used and the goods should be fed dry to the mercerizing liquor. Tables are given showing suitable wetting agents, the best conditions for mercerization with caustic soda with and without additions of salt, and with mixtures of caustic soda and potash, and the types of fibre mixtures for which these different methods are most suitable. The shrinkage and its dependence on temperature, the use of squeezing rollers, the need for care in rinsing, souring, and drying processes, and the loss in weight of staple fibre in mercerizing are discussed. (C)

TECHNICAL DYEING METHODS. C. L. Wall. *Text. Mfr.*, Sept. 1939, P. 410–1; Oct., P. 454, 457.

Limitations in adsorption methods of dyeing; the possibilities of continuous impregnation processes are discussed and some of the requirements. (C)

TEXTILE BLEACHING: COMMERCIAL USE OF LIQUID SULPHUR DIOXIDE IN. C. F. Ward. *J. Soc. Dyers Col.*, Sept. 1939, P. 445–8. (C)

THICKENING AGENTS: PHYSICAL PROPERTIES OF. Georg Hasse. *Mell. Textilber.*, 1939, No. 9, P. 655–8.

Practically all the thickening agents commonly used for calico printing yield viscosity curves, which shows that they possess more or less structural viscosity. The ordinary viscosity determination by means of the ball viscometer affords no information about the physical behavior of a thickening agent during printing, because measurement in that way takes no account of the shearing stress. Thickening agents are everywhere subjected to mechanical stress during printing owing to the movement that takes place during the process: while the thickening is running in the color-box of the printing machine, while it is being expressed from the engraving and while it is being spread in screen printing. It must consequently be assumed that only such methods will afford reliable information about the practical behavior of a thickening as give due consideration to mechanical stress. It is now possible to go a step further and carry out the test under a shearing stress corresponding to the average speed of rotation of the printing rollers. Interesting aspects are thereby disclosed for the preparation of synthetic thickening agents. In the case of these thickening agents there are no factors incapable of modification, as in the case of the natural products, but their properties, such as viscosity, tenacity, and so on can be influenced to a considerable extent during manufacture. Colorists do practically the same thing when mixing thickenings, but the extent to which it is possible is naturally limited by the properties of each single component thickening. Measurement of viscosity as a function of the shearing stress affords an insight into an extensive field from which it is possible to proceed to the investigation of the technical problems of calico printing, such, for example, as the important problem of levelling. Finally, we can also gain an insight into the fine structure of thickenings by their chemical and physical examination, and at some future date, as in other fields also, the empirical methods of testing thickenings for their practical application will yield to scientific examination. (C)

VAT DYES: APPLICATION OF—TO VISCOSE RAYON. J. Boulton and T. H. Morton. *J. Soc. Dyers Col.*, Oct. 1939, P. 481–97. (C)

VAT PRINTING PASTES: FUNDAMENTAL STUDY OF. Leland F. Gleysteen. *Am. Dye. Rptr.*, May 29, 1939, P. 280–4.

This is a progress report of Project 6–30 of the A. A. T. C. C. Part III covers the measurement of color yield; use of the Hunter Photox Reflectometer; the effect of thickener solids on color yield; a comparison of sodium and potassium carbonates; the causes of heat rise in an ager. (C)

WOOL DYEING: SIGNIFICANCE OF TEMPERATURE IN. II. STUDY OF THE ACID COMBINING CAPACITY OF WOOL. F. L. Goodall and C. Hobday. *J. Soc. Dyers Col.*, Nov. 1939, P. 529–49.

It is concluded that there is no justification for the assumption that the acid combining capacity of wool is independent of temperature, or for the further view that the capacity of wool for combination with both colorless and dye-acids is always the same. Confirmation of the latter view has been obtained at 20° C., but it has been established that wool shows an increased capacity for combination with both acid and acid dyes at high temperatures, and that the extent of the increase varies between acid and dye and between one dye and another according to the effective basicity and state of dispersion in solution of the dye concerned. (C)

WOOL FABRICS FOR PRINTING: USE OF SULPHURYL CHLORIDE IN TREATMENT OF. *Mell. Textilber.*, 1939, V. 20, P. 293–4.

The Dri-Sol treatment using sulphuryl chloride (*J. T. I.*, 1937, A331) is stated to be more satisfactory than wet chlorination for the preliminary treatment of wool yarns and fabrics for printing. The process is of special interest for the knitting industry, but is unsuitable for use on mixture fabrics of wool and staple fibre. (C)

IV. RESEARCH METHODS AND APPARATUS

STROBOSCOPIC DEVICES: APPLICATION. H. Stein. *Mell. Textilber.* (German Edition), 1939, No. 4, P. 262–6.

Only one person is able to carry out observations by means of a slotted disk stroboscope interposed between the observer and the object, but several persons can follow the motion at one time by designing the slotted disk as a cylinder and placing a source of illumination in the interior. The research institute of the AEG has designed stroboscopic equipment with such a powerful intensity of illumination that it is possible to make film exposures. The author gives a description of the instrument and gives numerous illustrations showing, for example, how the travellers on the ring spinning frame can be observed. (C)

RUBBER THREAD: DURABILITY TESTING. J. P. Griffiths and C. R. Pinnell. *Proc. Rubber Tech. Conf., London*, 1938, P. 672–85; abs. in *J. T. I.*, April 1939, P. A260.

Describes routine methods for testing the bare thread (chafing tests and stress/strain and hysteresis curves) and web or braid for resistance to various bleaching, dyeing, finishing and cleaning processes. (C)

SPINNING OILS: TESTING. H. Christoph. *Leipz. Monats. Text. Ind.*, 1939, V. 54, P. 79–88; abs. in *J. T. I.*, June 1939, P. A412.

The properties required in an oil for textile fibres, the types of oil used, and the causes of rises in temperature and fires in oiled materials on storing are discussed, and iodine and thiocyanogen number determinations and various other methods of testing oils are reviewed. It is pointed out that the conditions under which the Mackey test is carried out vary widely in practice and the need for standardization is emphasized. (C)

SURFACE-ACTIVE AGENTS: DETERMINATION OF SULFUR IN. Ralph Hart. *Am. Dye. Rptr.*, Feb. 6, 1939, P. 66–9.

A new, convenient, and accurate method has been developed for the determination of sulfuric anhydride in sulfuric acid esters and sulfonic compounds. The method is based upon the conversion of the respective compounds into their ammonium salts and determining the ammonia in the latter. (C)

TENSILE STRENGTH OF FIBRES. P. Larose. *Canadian Text. J.*, June 9, 1939, P. 35.

Holds that fibre tensile strength should be stated in grams per unit of area instead of on the basis of grams per denier. (C)

TESTING SEWING COTTON. Walter Frenzel and Willy Harzer. *Mell. Textilber.*, 1939, No. 6, P. 403–6.

It is pointed out that the breaking strength by itself is no criterion for the usefulness of sewing cotton. The authors propose to test the tension to which the thread is exposed when it has to overcome the resistance offered to its passage between rubber threads under the designation of its sliding capacity. The property thus measured takes into due account the external smoothness of the thread and its uniformity in thickness and roundness. For that purpose the Frenzel-Hahn Universal Yarn Testing Machine was used. This machine is fitted with a recording device that permits of tracing the variations in tension, the line giving a clear picture of the unevenness of the sewing cotton. A number of such diagrams are shown which reveal characteristic variations due to the finishing processes to which the thread has been subjected. (C)

TESTING SPUN MATERIALS: MODERN METHODS OF. H. Sommer. *Silk & Rayon*, 1939, Jan., P. 18, 20; Feb., P. 126, 128; Mar., P. 214, 216.

The first instalment describes and discusses single fibre strength testers; the second, testing the thread in movement, twist counter, tensile strength of fabrics, bursting strength; the third instalment covers resistance to continuous bending, resistance to creasing, compressibility, measurement of thickness, heat retaining capacity, permeability to air, steam permeability, water-resisting properties and weathering tests. (C)

(TEXTILE) RAW MATERIALS: PURCHASE STANDARDS FOR. THEIR DETERMINATION AND APPLICATION. *Text. Recdr.*, Jan. 6, 1939, P. 16–7. (C)

TEXTILE TESTS: SOME ROUGH-AND-READY. P. Krais. *Text. Mfr.*, April 1939, P. 148.

The author, who has had a life time's experience of technical and scientific testing, describes testing methods that make possible a quick or

preliminary decision, where there is no time nor occasion to use the microscope, the ultra-violet lamp, testing machines or the chemical laboratory. (C)

TIME AS A FACTOR IN ELONGATION AND LOADING TESTS. Walter Frenzel and Horst Bach. *Mell. Textilber.* (German Edition), 1939, No. 5, P. 331.

A flowing of the material is to be detected in many types of fibre when the load is maintained for a certain time, as can be specially well observed when dealing with rayon. Conclusions as to the behaviour of yarns under prolonged load may be drawn from the course of elongation of rayon in this critical state. The load may be of any extent below the breaking load. The two authors have drawn up spatial diagrams and give the results of the examination of various types of rayon. (C)

TOPS: CONSIDERATION OF EXPERIMENTAL METHODS FOR MEASUREMENT OF FIBRE LENGTH IN. B. A. Smith. *14th Int. Wool Conference, London*, 1938, *Tech. Cttee. Proc.*, P. 73; abs. in *J. T. I.*, April 1939, P. A258. (C)

TOPS: PRACTICAL METHOD FOR DETERMINING FIBRE LENGTH IN. A. Huberty. *14th Int. Wool Conference, London*, 1938, *Tech. Cttee. Proc.*, P. 74–9; abs. in *J. T. I.*, April 1939, P. A258. (C)

VISCOSE FILAMENTS: LOAD/EXTENSION CURVES AND STRUCTURE. P. H. Hermans. *Kolloid-Z.*, 1939, V. 86, P. 107–23; abs. in *J. T. I.*, June 1939, P. A406.

An attempt is made to bring the mechanical properties of viscose filaments with different degrees of orientation into a scientific system. The discussion is based on measurements of length, diameter, denier, degree of swelling, breaking load and extension of isotropic viscose filaments and filaments in which orientation has been progressively induced by stretching. It is demonstrated that the form of the load/extension curves varies with the degree of orientation, so that it is a fallacy to assign a particular type of curve to "cellulose" or to compare cellulose preparations with other substances (*e.g.*, rubber and wool) without taking orientation into account. (C)

WASHING: CHANGES PRODUCED IN STAPLE FIBRE FABRICS BY. H. Böhringer and H. Seyfert. *Mell. Textilber.* (German Edition), 1939, No. 5, P. 353.

It is stated as the result of tests that the observation of modifications of the degree of polymerization of staple fibre presents a valuable supplementary method for the supervision of fibres based on cellulose, because that factor—and more especially its examination by the fractionating and washing out method—leads to results that may be of great importance for the further development of the manufacture and use of the various types of staple fibre. The method affords an insight into the structure of the fibre, and is generally applicable for the examination of cellulose. It is also possible by this means to detect changes that take place, for example, during mercerizing and dyeing. Finally, the determination of the degree of polymerization must be demanded for the critical evaluation of the vari-

ous types of staple fibre, because the washing tests here described have shown that they possess much less reserves than cotton and consequently call for a further possibility of testing them. The detergents with a bleaching action that are commonly applied have a deleterious effect on cotton and even more so on staple fibre. (C)

WASHING METHODS: NEW VIEWS ON EFFECT OF VARIOUS—ON STAPLE FIBRE FABRICS. Oscar Uhl. *Mell. Textilber.*, 1939, No. 7, P. 511–3.

The introduction of the measurement of the degree of polymerization provides an unambiguous picture of the processes that take place during washing of staple fibre and there is no doubt that such measurements are valuable for the study of the effect of washing and are able in cases of doubt to throw light upon the washing process. (C)

WATERPROOFNESS OF FABRICS: TESTING OF. H. T. Fergusson. *J. T. I.*, June 1939, P. T99–102.

This test is an improvement on the generally accepted method of drop testing. A colored solution enables the penetration to be noted more readily. A cambered foundation avoids air pocketing which is difficult to overcome when using the plate glass method. The sample is readily placed in position and the draft excluder ensures that the drops shall fall on the same spot in each particular test. All types of fabric cannot be successfully tested in this way. An open weave fabric permits the drop to penetrate even if waterproofed well. When testing open weave fabrics a smaller jet can advantageously be used and vice-versa. This paper is published by permission of the Geigy Colour Co., Ltd., Manchester, Eng. (C)

V. PURE SCIENCE, ECONOMICS AND MISC.

HETEROGENEITY OF VARIOUS KINDS OF CELLULOSE. Lachs, Kronman and Wajs. *Kolloid-Z.*, Aug. 1938, P. 199–204; abs. in *Paper Trade J.*, July 27, 1939, P. 25. (C)

HIGHLY POLYMERIZED COMPOUNDS. 189. THE CONSTITUTION OF CELLULOSE. Staudinger, Holz, Roh and Werkstoff. *Ber.*, April 1938, P. 259–65; *B. I. P. C.*, V. 8, P. 371; abs. in *Paper Trade J.*, Mar. 2, 1939, P. 26.

There exists not one kind of cellulose but a homologous series of polymers of the same. The physical properties of native and regenerated celluloses depend on the degree of polymerization of their macromolecules and further on their threadlike form. The chemical and physical behavior of cellulose may be explained by a consideration of its macromolecular structure. Lignin, however, is not a highly polymerized substance. (C)

HYDRATION: EFFECT OF—UPON THE RATE OF DRYING OF PAPER SHEETS. J. G. L. Caulfield, L. C. Jenness and H. G. Macklem. *Paper Trade J.*, June 15, 1939, P. 27–30.

A correlation between drying rate and freeness is developed, depending upon a shift of the critical moisture content toward higher free moisture contents with increasing hydration, resulting in decrease in average drying rate for a given removal of moisture. There is presented a calculation of

the time required during the period of constant rate drying and during the two periods in which the rate is falling, for a range of values of freeness. (C)

HYDROGEN-ION CONCENTRATION: A MORE RATIONAL METHOD OF STATING. L. M. Booth. *Paper Trade J.*, Feb. 23, 1939, P. 116–24.

The prevailing method of expressing hydrogen-ion test data is complicated. Too much explanation is needed. Confusion arises from the lack of familiarity with logarithms by the majority of those who are concerned with pH readings. In that portion of the pH scale near the neutral point minor differences of hydrogen-ion concentration are too strongly stressed. In the ranges remote from the neutral point, major differences are minimized.

Dr. E. T. Wherry, Botany Dept., Univ. of Pa., has proposed an arithmetical system of statement of hydrogen-ion test data which may be easily comprehended. His plan and the reasons for its adoption to supplant the commonly used reciprocal logarithmic method of statement of results, form the basis of this presentation. The adoption of the symbol AA, representing arithmetical values of Active Acidity and Active Alkalinity, to supplant pH reciprocal logarithmic numbers is recommended. (C)

MECHANICAL DRYING AND FINISHING. P. Leyendecker. *W. P. Z.*, (1) 1938, V. 41, P. 775; (2), P. 794; abs. in *J. T. I.*, April 1939, P. A265.

A summary and discussion of practice in German laundries. (C)

MECHANISM OF THE DEFORMATION OF FIBROUS MATERIALS: BIREFRINGENCE OF HERMAN'S HYDRATED CELLULOSE FIBRES. O. Kratky and P. Platzek. *Koll. Z.*, Sept. 1938, No. 3, P. 268–75; abs. in *Eastman Kodak Abs. Bull.*, Mar. 1939, P. 181.

The concept of "form" and "intrinsic" birefringence is applied to cellulose fibres swollen in different media. By the application of Wiener's quantitative expression it is possible to express these properties numerically, and thus to estimate the angular micellar orientation. (S)

METALLIC COMPOUNDS OF PROTEIN. F. Lieben. *Nature*, Sept. 10, 1938, P. 463–4; abs. in *Eastman Kodak Abs. Bull.*, Feb. 1939, P. 107.

The violet color obtained in the biuret reaction of proteins consists of two components. The extinction coefficients, when plotted against the copper sulfate added, give straight lines cutting at an angle, the solutions becoming bluer as the amount of copper is increased. Experiments on casein show that other metals combine with the protein in such a way that one metal atom corresponds to x atoms of copper, where x is 2 for nickel, 3 for cobalt, 1 for silver, and 3 for gold. There is evidence that copper is attached to carboxyl groups of the protein in acid solutions, and to imino- and amino-groups in alkaline solutions. (S)

PLANT CELL WALLS: CHARACTERIZATION OF BY TREATMENT WITH CUPRAMMONIUM SOLUTION. R. Siegfried and J. Pfützenreuter. *Ber. deut. chem. Ges.*, 1938, V. 71, No. 10, P. 2220–2; abs. in *Eastman Kodak Abs. Bull.*, Mar. 1939, P. 181.

Cuprammonium solutions of various plant fibres were filtered and the copper content of the undissolved portion was determined. The deciduous

plants gave an average copper content of 7%, the conifers, 10%, and the long-fibred materials, 13%. After treatment with 5% sodium hydroxide solution, the addition of copper was increased in all cases. Nitrogen was also absorbed from the cuprammonium solution. This varied from 0.53% to 1.06%. The material not dissolved in cuprammonium varied from 80% to 96%, for the conifers. The amount of this residue was gradually reduced by repeated treatments with cuprammonium.

PROFITABLE RESEARCH. J. E. Bullard. *Am. Dye. Rptr.*, Feb. 6, 1939, P. 76–8.

PROTEIN MOLECULES: REVIEW. T. Svedberg and others. *Proc. Roy. Soc.*, 1939, V. A170, P. 40–79; abs. in *J. T. I.*, June 1939, P. A423.

(Pages 40–56) In an opening address Svedberg surveys the state of knowledge of the protein molecule and the means which are used at present and those which might be used in the near future for its study. A table of the molecular constants of proteins is presented along with a copious bibliography. (Pages 56–79) Separate contributions to the general discussion by well-known workers include papers by F. J. St. L. Philpot on the effect of calcium on the sedimentation constant of casein, Dorothy M. Wrinch on the geometrical attack on the problem of protein structure, A. Neuberger on a chemical criticism of the cyclol and frequency hypothesis of protein structure, K. H. Meyer on protein denaturation, W. T. Astbury on evidence from the X-ray study of fibrous proteins, and J. D. Bernal on X-ray evidence for the structure of the protein molecule. (C)

PROTEINS: STRUCTURE OF. I. Langmuir, W. L. Bragg, J. D. Bernal, J. M. Robertson, W. T. Astbury and F. O. Bell. *Nature*, 1939, V. 143, P. 34–5, 73–6, 280; abs. in *J. T. I.*, April 1939, P. A291.

Various aspects and theories of protein structure are presented, with special reference to vector maps and crystal analysis, and the cyclol hypothesis. (C)

RAYON STAPLE FIBRE PROBLEMS: POOLING OF "IDEAS" URGED. Kenneth N. Merrill. *Text. Age*, Jan. 1939, P. 47–8. (C)

STABILIZATION OF CELLULOSE ACETATES. M. Jeanny. *Rev. gén. mat. plastiques*, Jan. 1938, P. 7–9; abs. in *Eastman Kodak Abs. Bull.*, Mar. 1939, P. 184.

A review is given of various stabilization processes, including those of Kuhlmann, Sindl, and Afag Finanzierung. These involve treatment of the cellulose acetate with dilute mineral acids or suitable organic liquids. (S)

STARCH PASTES: VISCOSITY AND GRANULE STRUCTURE. J. R. Katz, M. C. Desai and J. Seiberlich. *Trans. Faraday Soc.*, 1938, V. 34, P. 1258–68; abs. in *J. T. I.*, April 1939, P. A273.

Experiments on 1% pastes of potato and corn starches are described to show that changes in viscosity can be explained by changes in microscopical structure of the granules. Paste is built up of swollen starch vesicles with water between them. When heated or mechanically treated the thin

vesicle wall breaks and breaks much more readily under mechanical treatment on heating than at room temperature or at 0° C. At lower temperatures the walls are elastic instead of plastic. Even in 1% pastes the viscosity characteristics are very complex and the factors which contribute to this complexity are probably the small amount of free water between the vesicles and the rubbing of these vesicles against one another. (C)

STARCH: STRUCTURE AND TECHNICAL PROPERTIES. M. Samec. *Papier Fabrik.*, 1938, V. 36, *Techn.*, P. 495–7; abs. in *J. T. I.*, April 1939, P. A285.

A useful review of the properties of the amylose and amylopectin fractions of starches. (C)

Science and Empiricism

Gears made of impregnated cotton fabric that are shaped under tremendous pressure have been made by the General Electric Co. for many years. Now the *Science News Letter* quotes L. M. Tichvinsky, of Westinghouse Research Laboratories, as describing bearings, somewhat similarly made with a woven textile base, which require no oil or grease but perform efficiently with water as a lubricant and cooling agent, even when used for giant steel mill rolls or for the shafts of large ship propellers.

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Retting of flax in the river Lys, Belgium, is to be forbidden after April 15, 1943, by a decree of the Belgian Government. The high quality of Courtrai flax is reported to be due in large part to its retting in the Lys, and were it not for the fact that a hot water retting process developed in Oregon is competing satisfactorily with the river Lys, this decree would be a serious matter. Having a satisfactory substitute, however, Courtrai citizens are now willing to admit that rotting flax in the Lys stinks.

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Lacking native spruce and cotton linters, that are the main sources of cellulose for the synthetic fibre industry in this country, the Italian industry (standing fourth in world production) uses for 40 to 50% of its raw material annual plants such as cereal straws, and for the balance alpine timbers, poplar and euclayptus woods, reeds, sugar cane, broom, hemp chaff, esparto, papyrus, canna, etc. Japan, now the leader in productive capacity, and Germany ranking third have also been using a variety of similar native sources of cellulose. Economic conditions make necessary the use by these countries of relatively inferior sources of Alpha cellulose, and relatively low wages make it possible. The millions of tons of these materials that go to waste in this country each year emphasize the inexhaustible supply of cellulose that is available.